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MASS REARING THE CORN EARWORM IN THE LABORATORY[1]

By R. L. Burton[2]

Rearing insects in the laboratory has become a common practice since the diets and techniques devised in the last few years have allowed researchers to culture several of the species that are more important economically. Reviews of these advances in technology are available to serve as aids in the development of newer rearing programs. A good overall review of insect rearing is presented in "Insect Colonization and Mass Production" (10).[3] A general review of artificial diets is provided by House (6), who calls his publication a "recipe book of artificial diets for insects". Vanderzant (11) is more specific and confines her review to wheat germ diets for insects. These workers have assembled much useful information on this subject.

Although based on previous technology, the insect rearing program at the Southern Grain Insects Research Laboratory, Tifton, Ga., has been modified and improved to increase efficiency and achieve desired results. This publication presents an outline of the materials and techniques currently used in this laboratory for large-scale rearing of the corn earworm [Heliothis zea (Boddie)].

ARTIFICIAL DIETS

The wheat germ diet discussed by Vanderzant (11) was used successfully in our laboratory for several years to rear the corn earworm (12, 1) and the fall armyworm [Spodoptera frugiperda (J. E. Smith)]. However, we now use a modification of a bean diet introduced by Shorey and Hale (9), which produces good results with less expensive materials and is much easier to formulate. Our modifications include the addition of large amounts of wheat germ and the replacement of brewer's yeast with less expensive Torula Yeast.[4] These modifications appear to increase the rate of larval growth and shorten the time to pupation. The reasons are not known, but the effect of the wheat germ could be mechanical or nutritional. This modified bean diet has also increased the number of tobacco budworms [Heliothis virescens (F.)] reared from an average of less than 1 (using the wheat germ diet) to 1.75 pupae collected per 1-ounce rearing container.[5]

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[3] Underscored numbers in parentheses refer to Literature Cited, pp. 7 and 8.

[4] Source of Torula Yeast: Lake States Division, St. Regis Paper Company, Rhinelander, Wis. 54501.

[5] Personal communication, C. R. Gentry, Entomology Research Division, Agr. Res. Serv., USDA, Quincy, Fla. 32351.

The ingredients of the modified bean diet and the amounts necessary to prepare about 8 gallons are shown in table 1. It is preferable to soak the pinto beans overnight. But when time does not permit, they may be coarsely fragmented and added dry. The same amount of water is added, however, so the total volume is reduced. In our laboratory, the diet is prepared in a 10-gallon blender (Hobart VCM 40E) and processed using the machine, cups, and trays described by Burton and Cox (3), except that the larval dispenser and capper are omitted. Patana (8) describes a good alternate dispensing technique for smaller amounts.

Table 1.--Modified pinto bean diet used at the Southern Grain Insects Research Laboratory to rear corn earworms

Ingredient	Amount in grams
Pinto beans	[1] 6,900
Dried Torula Yeast	1,024
Wheat germ	1,600
Ascorbic acid	104
Methyl p-hydroxybenzoate	64
Sorbic acid	32
Formaldehyde 10%	256
Water in blender	10,400
Agar	408
Water for dissolving agar	10,080

[1] 3,360 grams of dry beans soaked overnight and drained.

REARING PROCEDURES

Adults

Adults are placed in cages made of 1-gallon ice cream cartons with disposable wrapping paper liners for oviposition. Each cage has a solid bottom, and a piece of cotton sheeting serves as the top of the cage and the site of oviposition. The liners are removed periodically to remove the few eggs (if any) oviposited on the sides of the cage. Tests to determine the optimum number of moths per cage for maximum oviposition indicated that oviposition per female is the same whether 10 or 20 pairs of adults are used per cage; however, when 20 pairs are used, the fertility of the eggs decreases to about half, so the smaller number of pairs per cage is used.

The moths feed on a small piece of cotton soaked with beer that is placed in a small disposable soufflé cup and is replaced daily when the eggs are collected. Adults are handled in a darkroom (2) equipped with a heavy screenwire work surface. Two large squirrel cage fans pull a strong current of air over and through this work surface and then through a filter. Thus, when a cage is opened, the insect scales are pulled down through the work surface and filtered and removed from the air in the room. Filters are vacuumed periodically to remove the scales. This system permits large numbers of cages of moths to be handled without an insect-scale health hazard. No vents are necessary, and air in the room is recirculated.

Eggs

Surface sterilization of the eggs is necessary to control certain pathogenic organisms that affect corn earworms. Sodium hypochlorite is an effective surface sterilant (4, 7) and also loosens the eggs from the cotton sheeting.

The cloths are removed from the cages and shaken slightly to remove any larvae or other foreign materials. They are first placed in a large pan containing a 0.157 percent sodium hypochlorite solution and are agitated slightly. After 3 minutes the cloths are transferred quickly to another large pan of fresh water. The solution in the first pan (which contains most of the eggs) is immediately poured through an organdy filter in the rinse system shown in figure 1. Any remaining eggs are removed from the cloths by a second and third wash which are poured through the filter. A 10 percent solution of sodium thiosulfate is poured over the eggs to stop the action of the sodium hypochlorite. The eggs are then rinsed for 5 minutes in the rinse system and are transferred to a large beaker where they settle to the bottom. Trash and the few eggs that float are removed by several washings with fresh water, and any lint can be removed with a pair of clean forceps. Then the eggs are transferred to a graduated cylinder, measured volumetrically, transferred to a small squeeze bottle, and sprayed onto squares of dark Dacron and cotton broad cloth.[6] These cloths are spread in a drying area at room temperature. When the cloths are almost dry, the temperature is increased, because once the fabric is completely dry the eggs can be brushed free (fig. 2); if the cloth is damp, the eggs cannot be removed without damage and they clump. The dry eggs are single and can be manipulated easily.

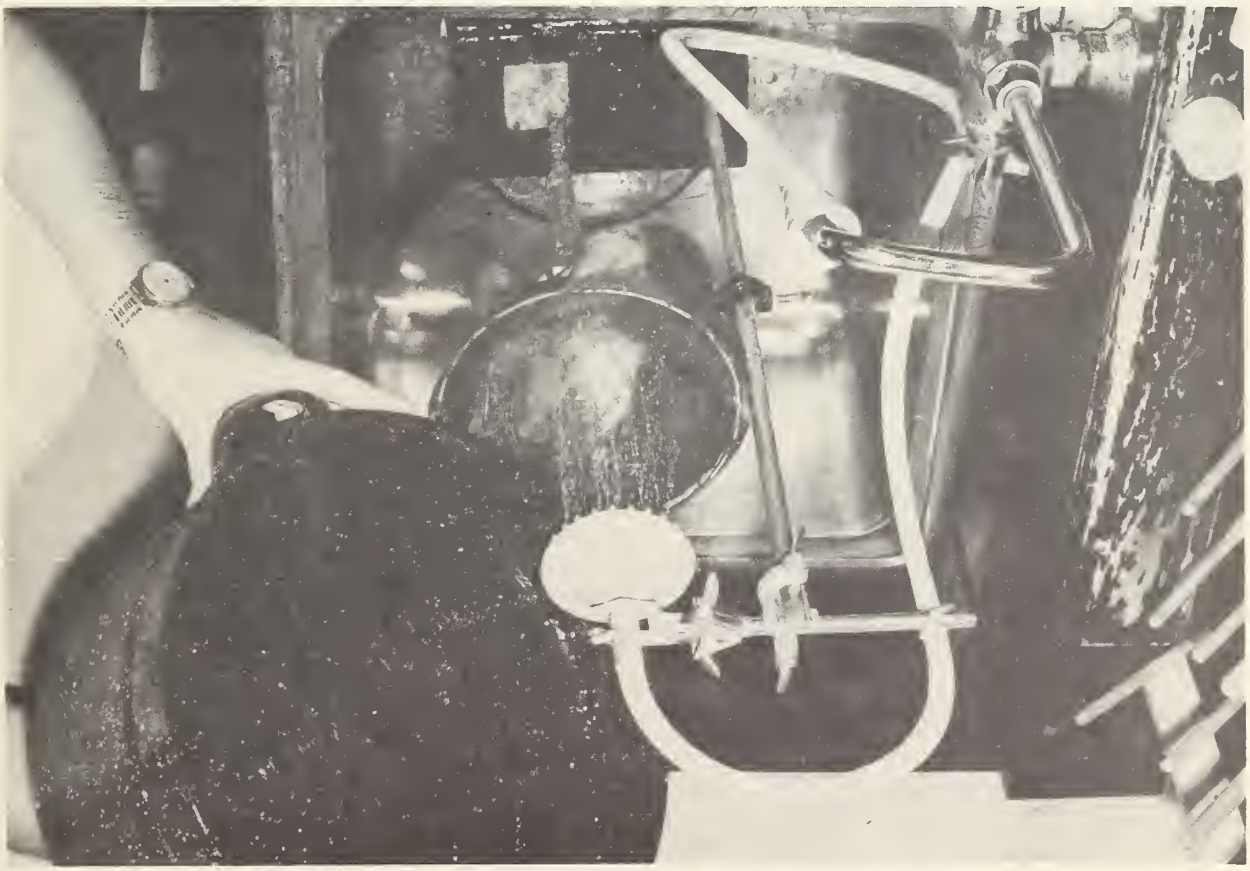

Figure 1.--System used to rinse corn earworm eggs.

[6]Similar to a technique used by A. R. Chauthani, Nutrilite Products, Inc., Buena Park, Calif. Personal communication.

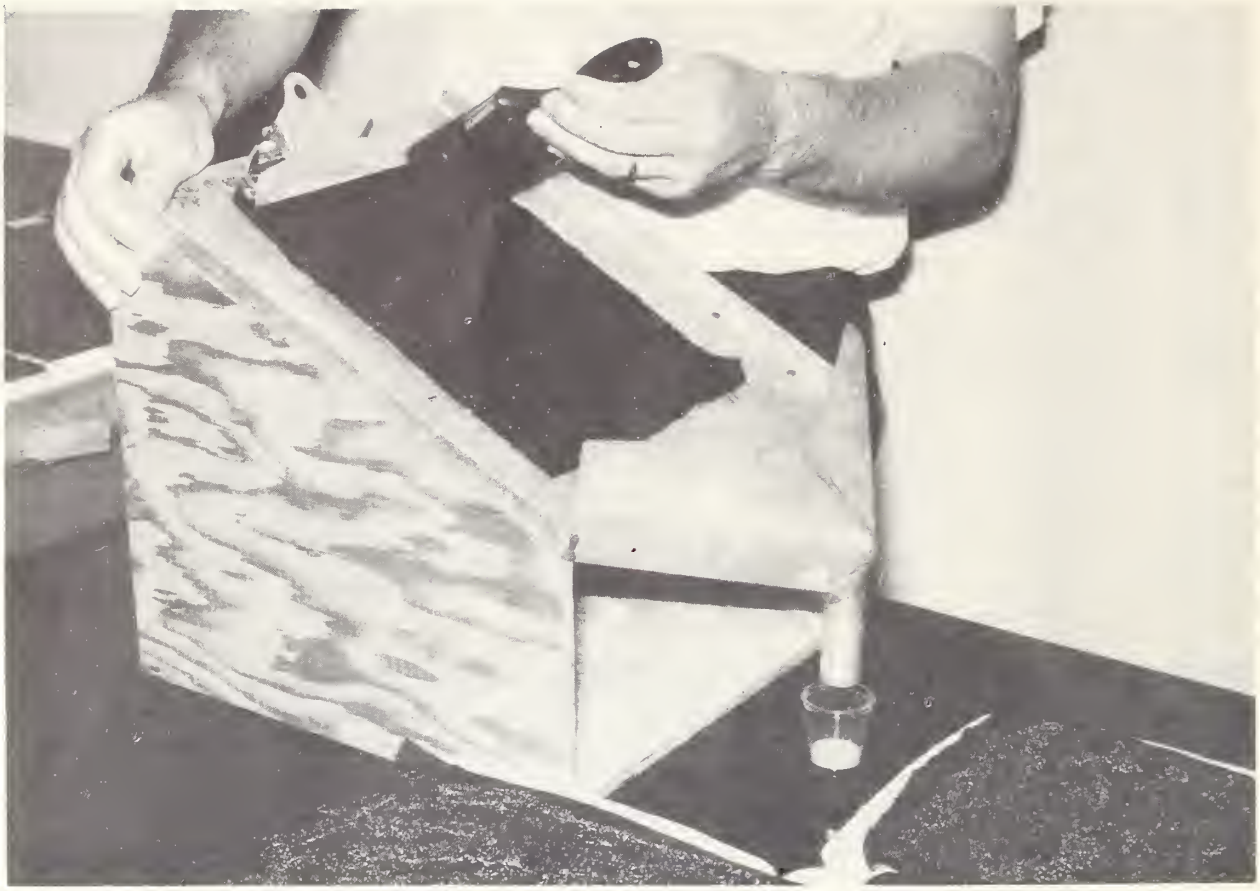

Figure 2.--Brushing eggs from fabric after drying.

Infestation of Diet with Eggs; Incubation of Larvae, and Collection of Pupae

The loose eggs are shaken through a 1-mm. hole in the shoulder of a 17- by 100-mm. round-bottomed plastic test tube onto the diet in the rearing cups. From two to six eggs are placed in each cup depending on the condition of the eggs. This process becomes rapid as the worker becomes adept at using the device. After the cups are infested, the eggs and young larvae are incubated for 8 to 10 days at a moderately high relative humidity (80 percent) and temperature (29°C.) to prevent desiccation. Then the cups are moved to an area with the same temperature but with a moderately low relative humidity (40 percent) and extremely good air circulation, until pupation. This change in environment reduces the incidence and degree of microbial contamination as well as the losses due to larval escapes. Pupae are collected from the containers with the machine designed, built, and described by Harrell and others (5) for this purpose.

Emergence of Adults

An air-conditioned room, completely lined with wrapping paper, is used for adult emergence. The pupae are held in shallow cardboard trays at about 75° F. Then, when the adults are to be collected, the temperature is dropped to about 55° to reduce the movement of the moths and make it easier to capture

them. Since the sexes are easy to distinquish at this stage, they can be collected in separate containers immediately. A hair dryer or a vacuum cleaner, modified for the purpose, collects the moths from the walls, ceilings, and floors, and from wide pieces of cheesecloth hanging from the ceiling. Large numbers of adults can be sexed and handled rapidly, and little, if any, mating occurs when the moths are collected daily.

COSTS

Costs per 1,000 infested containers averaged about $16 in 1968. This price includes labor ($8), containers ($4.50), diet ($2.50), and miscellaneous ($1).

SUMMARY

An earlier pinto bean diet has been modified and is being used successfully to rear corn earworms, [Heliothis zea (Boddie)].

Ten pairs of adults are placed in a 1-gallon ice cream carton and are allowed to oviposit on a fabric top. The eggs are surface-sterilized and removed from the fabric, sprayed onto other fabric, dried, and brushed free. Then they are shaken onto cups of diet. The eggs and larvae are held at a high humidity during the first half of the larval cycle, but are exposed to low humidity during the last half. Adults are allowed to emerge in an open room and are sexed as they are collected.

Costs averaged about $16 for 1,000 containers.

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